Systematic Literature Review of Flipped Classroom: Models, Strategies, Tools, Challenges and Future Directions

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Abstract
With the widespread application of flipped classrooms, Instructional Design(ID) within flipped classrooms has received a lot of attention. Despite its importance and potential in the field of education, instructors or designers continue to find Instructional design challenging, and there still exist gaps regarding instructional design models, instructional strategy, technological tools, and platforms, as well as recommendations for future study. This systematic literature review analyzed 16 articles implementing the PRISMA framework to address these gaps. The analysis of these articles suggested developing a more technology-integrated, more learner-centered instructional design model. The research on ID should include a variety of instructional strategies, such as inquiry-based learning, project-based learning, etc. In addition, personalized and data-driven tools or platforms should be developed to facilitate personalized learning for students. This review reveals trends and recommendations related to ID in flipped classrooms. It can serve as the foundation for future research on ID in the educational context
Keywords: Systematic Literature Review (SLR), Technology, Flipped Classroom, Instructional Model, Instructional Strategy.

Introduction
        Technology has become an essential part of educational settings. The integration of technology not only enhances the learning experience but also signifies a transformative shift in how education is delivered. Among the instructional approaches that integrate technology in classrooms, a flipped classroom (FC) is a learning setting where conventional teaching methods are reversed or "flipped". Flipped classrooms have been adopted in

many fields combining a variety of technology (Zainuddin & Halili, 2016). This adoption underscores the urgency and relevance of studying instructional design in flipped classrooms, as it directly impacts the effectiveness of technology integration. The key component of this educational revolution is instructional design, a painstaking process that entails creating a smooth and productive learning environment for students. Effective instructional design is paramount in leveraging the potential of flipped classrooms, making it an indispensable area of study for educators and researchers alike. The goal of educational technology is to influence and enhance student learning in classrooms, therefore teachers need to utilize software and applications to develop essential course materials. This necessity highlights the growing significance of instructional design in optimizing educational technology's role in flipped classrooms. That is why instructional design is becoming increasingly important in the context of flipped classrooms (Arslan, 2020). In addition, the role of the instructional designer is crucial in guaranteeing that learning experiences are well-planned, engaging, and effective(Manurung, 2017). This study emphasizes the utility of instructional design for educators, providing them with the tools to create more interactive and student-centered learning experiences. Arslan (2020), proposed that educators or designers should take considerations such as content, pedagogy, material, delivery, and assessment in the design of the flipped classroom. By focusing on these elements, instructional designers can significantly improve the quality of education and the learning outcomes for students.

A flipped classroom offers an effective method for teaching and learning. In this learning setting, the traditional classroom activities are moved outside the classroom, usually through digital technology. This allows class time more used for interactive and student-centered learning experiences(Hwang, Lai, & Wang, 2015). Gilboy, Heinerichs, and Pazzaglia (2015), have highlighted that students' engagement has enhanced in flipped classrooms. Missildine, Fountain, Summers, and Gosselin (2013), used a quasi-experimental design to compare the different learning approaches to learning. The findings showed that the flipped classroom improved significantly student performance. In addition, flipped classrooms have been found to improve student motivation, and students feel more competent, independent, and a part of the group within flipped classrooms (Dierdorp, 2021). However, there are some significant challenges in the flipped classroom, such as insufficient student preparation, increased workload for instructors, student resistance, etc(Akçayır & Akçayır, 2018), students' unfamiliarity with the flipped classroom, issues with lecture videos, and lack of necessary instructional support (Lo & Hew, 2017). Considering this, it is essential to have a well-organized instructional design process, meticulous planning, and cautious strategic execution when putting the flipped classroom technique into practice.

This study aims to provide new information on instructional design (ID) models, strategies, technological tools, and future research recommendations in the Flipped classroom learning setting. This aim is crucial for advancing the field, as it not only informs current practices but also guides future innovations in instructional design within flipped classrooms. This study followed other researchers' approaches (Abuhassna & Alnawajha, 2023a, 2023b). Despite the researcher's effort to locate research dating back to 2004, it appears that the earliest articles relevant to instructional design in the context of the

flipped classroom are from 2012. Therefore, the publication year for pertinent materials seems to start in 2012, and only 19 articles can be downloaded from Scopus.

Therefore, the purpose of this study is to conduct a systematic literature review about Instructional design within flipped classroom settings, providing new information for future researchers on ID models, categories, instructional strategy, future research recommendations, and research needs for ID within flipped classroom settings. This leads to the research questions as follows:

1. What ID Model did previous studies employ in the context of flipped classrooms?
2. What Instructional strategy did previous studies employ in the context of flipped classrooms?
3. What Technological tools and platforms did previous studies employ in the context of flipped classrooms?
4. Where geographically were previous studies conducted?
5. What are the Challenges and limitations of previous studies in the context of flipped classrooms?
6. What are the proposed recommendations for the future development and enhancement of instructional design within flipped classroom environments?

Materials and Methods

This comprehensive SLR seeks to provide insights into instructional design models, strategies, technological tools and platforms, challenges and limitations, and recommendations for future research on the flipped classroom, to benefit upcoming scholars. The review adhered to the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)(Moher et al., 2009).

Exclusion and Inclusion Criteria

The present study established precise standards for inclusion and exclusion in order to guarantee that the selected publications met the research objectives, which were informed by research questions obtained from identified gaps in the literature. These criteria were developed after extensive examinations of relevant literature, and their formulation is of utmost importance. Table 1 contains the specific inclusion and exclusion criteria for this systematic literature review (SLR).

Table 1
The Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Flipped classroom, instructional design, instructional technology,	Research in different environments than instructional design on the flipped classroom.
Articles only	Conferences, blogs, theses, and book chapters
Written in English.	Any other languages.
The period from 2004 to 2023.	Publications from 2024 have been omitted as the year has not yet concluded.
Subject area (social science, computer and arts).	Any other subject area.

Sources of Data and Search Methods

The first phase of PRISMA is identification. Scopus was chosen as the data source due to it is the most prominent and extensively utilized indexing organization in the world. This systematic literature review (SLR) has thoroughly examined academic literature on current issues by using highly specific and restricted sets of keywords and search terms. The search for articles was started in January 2024, examining publications from 2004 to 2023; the year 2024 was excluded because it is not yet complete. The keywords "flipped classroom" and "instructional design" were both utilized. After searching on Scopus, 152 articles were included in the first draft of this study. A combination of keywords and phrases implemented are shown as follows: TITLE-ABS-KEY ("flipped classroom" AND "instructional design") AND PUBYEAR > 2013 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "COMP") OR LIMIT-TO (SUBJAREA, "ARTS")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))

Then the second phase of PRISMA is screening. A total of 152 articles underwent screening. To assist future scholars, a thorough analysis, guided by specific inclusion and exclusion criteria, narrowed down the selected papers to 73. These papers collectively delved into research on instructional design (ID) models, instructional strategies, and technological platforms, and provided recommendations for future studies on the flipped classroom. After that, the researchers downloaded papers from every one of the 73 publications that were part of our study. Despite multiple attempts, only 19 of the 73 items could be accessed. Various reasons, such as limited access and closed-access journals, accounted for the unavailability of the remaining items. According to researchers, the submitted papers are deemed sufficient both in terms of quantity and diversity. Three publications were excluded after screening according to inclusion and exclusion criteria. These publications were excluded because they used the phrase "instructional design" but didn't involve flipped classrooms. Furthermore, a metacognitive analysis was identified that focused on flipped classrooms but did not incorporate instructional design. At the end, in the phase of included, 16 publications were chosen to be included in this study, as shown in Figure 1
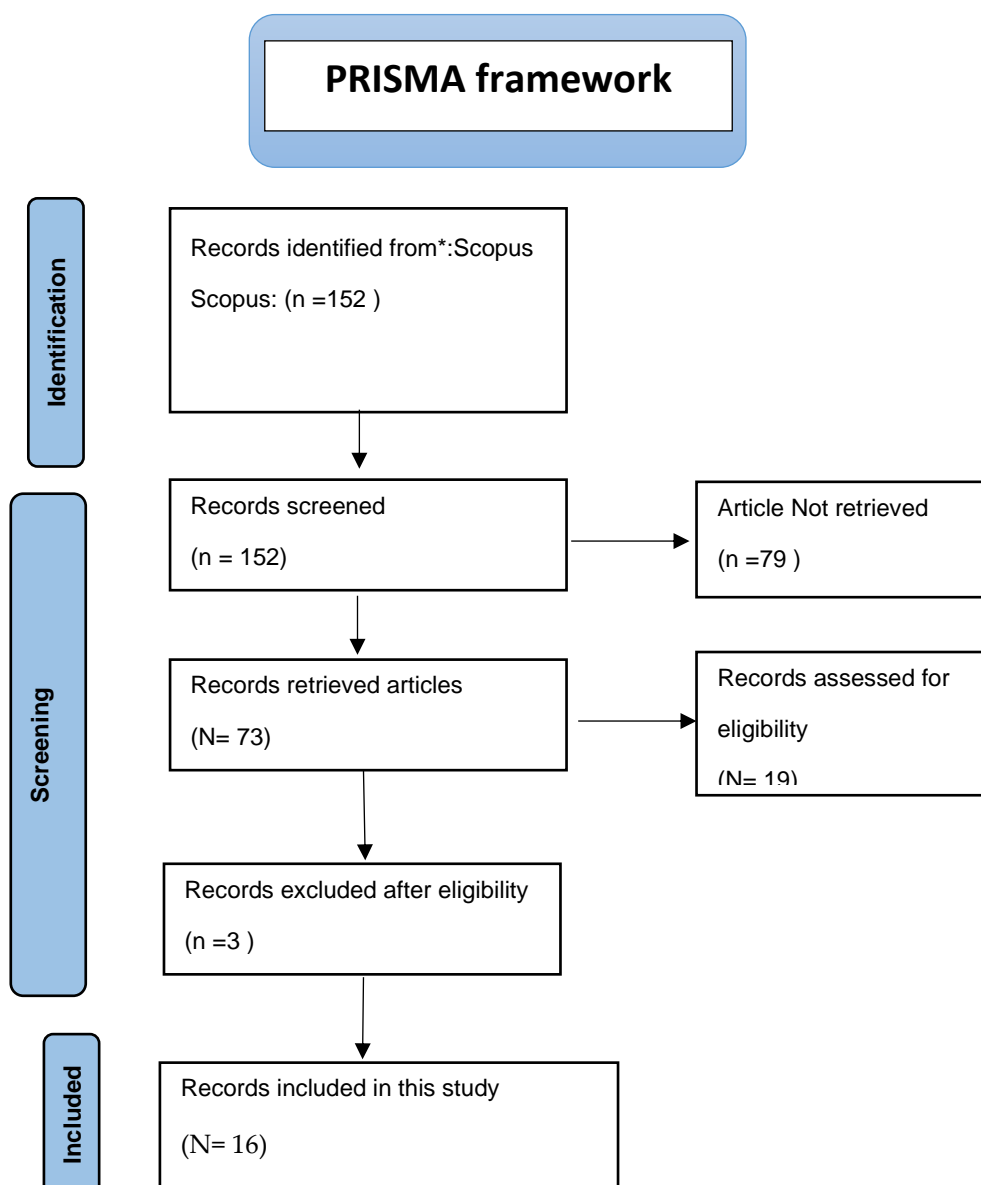
PRISMA framework

Identification

Records identified from*:Scopus

Scopus: (n =152)

Screening

Records screened

(n = 152)

→ Article Not retrieved

(n =79)

Records retrieved articles

(N= 73)

→ Records assessed for

eligibility

(N= 19)

Records excluded after eligibility

(n =3)

Included

Records included in this study

(N= 16)

Figure 1. The PRISMA framework.

Results

To achieve the research objectives, 16 papers were selected, reviewed, and incorporated following the PRISMA framework. These papers were subjected to an in-depth and analytical evaluation to ascertain the trends and developments in Instructional Design (ID) specific to flipped classroom environments. A detailed list of the articles that were scrutinized and included in this analysis is provided in Appendix A of this systematic review.

Instructional Model employed with the flipped classroom

Based on the analyzed publications, the researchers employed different kinds of Instructional models within flipped classrooms. The authors of A1 used the Database model and ADDIE model in their study. The authors of A2 used the DDR model. The authors of A3 used TPACK and teacher efficacy theories in their study. The authors of A4 implemented a Constructivist-based model in their study. The authors of A5 utilized Tisch Library's asynchronous tutorial modules. The authors of A6 implemented a Four-element flipped learning model, which refers to situation, interaction, experience, and reflection. The authors

of A7 used Question-embedding flipped classrooms which incorporate questions during pre-activities. The authors of A8 used concept maps and the authors of A9 utilized Flipped Classroom Model. In A10, the authors used OER(Open educational resources) flipped classroom. The authors of A11 employed Design heuristics and the authors of A12 implemented a motivational model. In A13, the authors used a Task engagement flipped classroom model. The authors of A14 used Without cognitive overload instructional design. The authors of A15 utilized the "O-PIRTAS" model, which refers to Objective, Preparation, Instructional video, Review, Test, Activity, and Summary. The authors of A16 implemented Educational data mining in their study. Based on the analysis of the collected publications, the instructional design model can be categorized into the following four types. Table 2 lists the 4 types of instructional design models and their explanations.

Table 2
Instructional Design Model used and Their Explanations

Article	Instructional design model	Explanation
A1, A3	Technology-Integration Models (e.g., TPACK, Database Model)	This kind of instructional design model emphasizes the relationship between technology, pedagogy, and content by emphasizing the integration of digital tools and platforms into the educational process.
A2, A6, A15	Systematic Design Models (e.g., ADDIE, DDR Model):	Systematic design models are characterized by a structured and phased instructional design method, in the meantime emphasizing analysis, development, implementation, and evaluation
A4, A12	Learner-centered Models (e.g., Constructivist-based Model):	Learner-centered models prioritize active learning and adaptability to the needs and backgrounds of learners, with a focus on improving their critical thinking and problem-solving skills.
A15	Data-Driven Models (e.g., Educational Data Mining)	The data-driven model advocates using data analysis to adapt to the behavior and preferences of learners, in order to achieve optimization of learning experience and outcomes.

Types of Instructional Strategy

Understanding the types of instructional strategy is important for justifying the choice of instructional strategy for future studies and identifying the current knowledge gaps in instructional design, particularly in the context of a flipped classroom. Based on our analysis of the instructional strategy employed in the selected publications, it can be concluded with a high degree of certainty that the overwhelming majority of instructional strategies employed for instructional design consist mostly of "active learning"(A5, A6, A7, A8, A10, A12, A14, A15). Eight (n = 8) total samples were collected in total, among which, active learning constituted 50% of the entire collection. Only 19% (n=3) of the examined publications comprised the "collaborative learning" instructional strategy(A3, A9, A13). In addition, 6%(n=1) of the studies surveyed "Projected-based learning"(A2). Moreover, 6%(n=1) of the studies on "Inquiry-based learning" were surveyed(A11). Moreover, 6%(n=1) "technology-integration". Only 13%(n=2) not mention the instructional strategy in the selected studies. Figure 2 illustrates the distribution of instructional strategy across the analyzed publications.
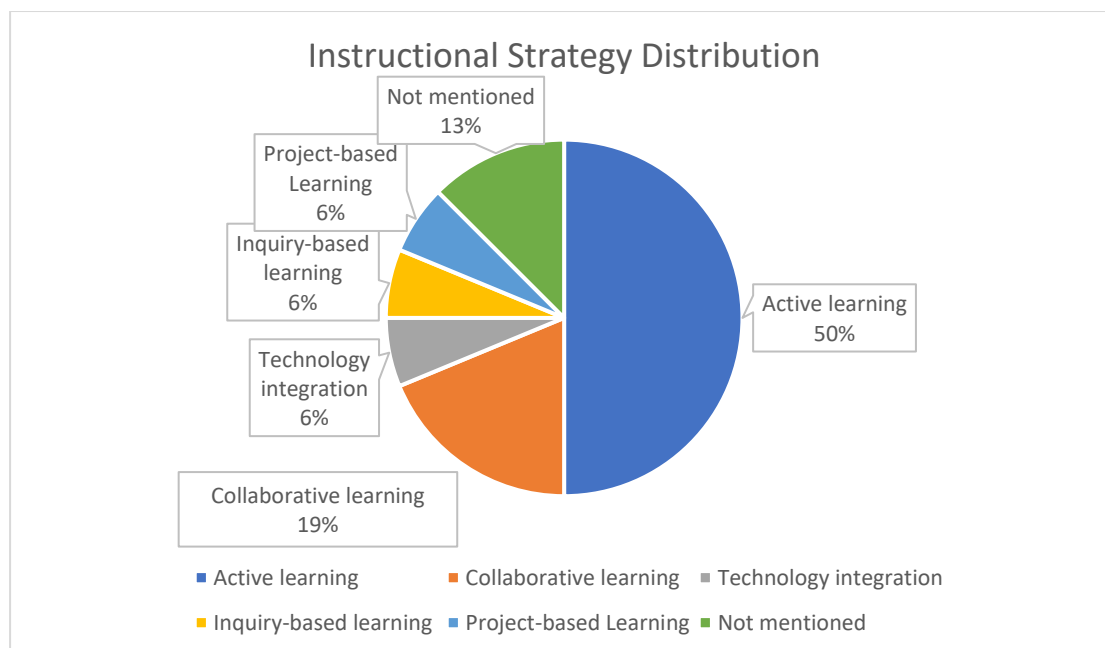
Figure 2. Instructional Strategy distributions

Variety of Technological Tools and Platforms

Our examination of the chosen articles demonstrates a variety of technological tools and platforms that are being seamlessly integrated into flipped classroom settings. They can provide a reference for future ID researchers to understand the knowledge gaps within flipped classroom settings. Among the chosen articles, 12.5%(n=2) of the examined studies employed Moodle(A10, A12), 12.5%(n=2) conducted their research via Zoom(A4, A5), and 25%(n=4) implemented LMS(A2, A9, A11, A14) in their research. Furthermore, the remaining research employed a wide range of technological tools and platforms, with 8 publications (50%) utilizing the following: A3 Unipus within the flipped classroom, A6 Rain classroom, A7 suggested TronClass, A8 Xiaoya online learning platform, A1 Database Management System (DBMS), A15 online learning platform, A16 MyEducator platform, A13 Canvas online learning platform. Figure 3 shows Technological tools and platform distributions.
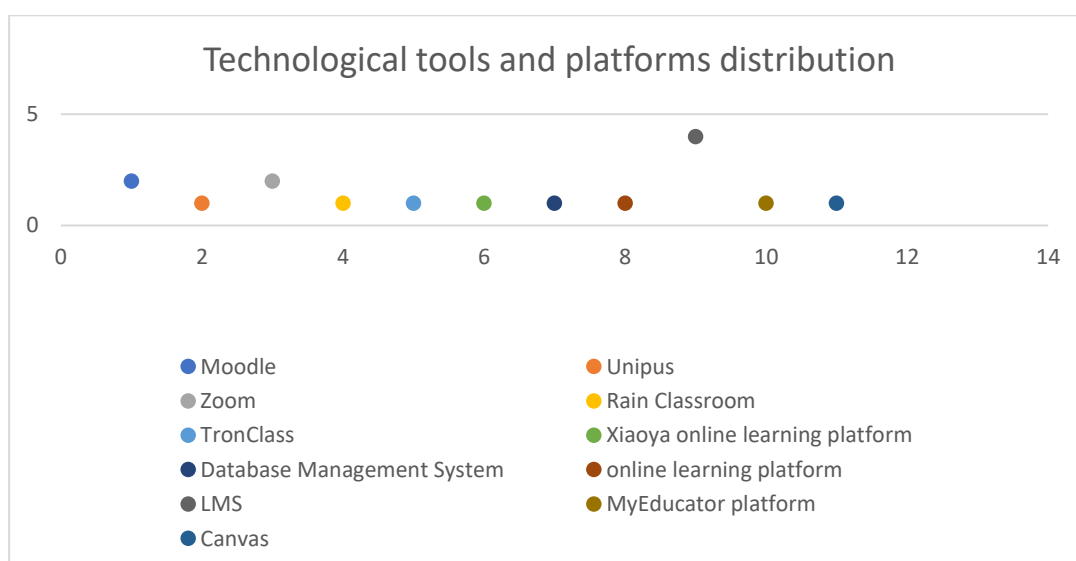

Figure 3. Technological tools and platform distributions

Geographical Locations

The study of Instructional design within flipped classroom settings is geographically diverse. However, it is evident that a significant level of research activity about instructional design within flipped classroom settings in China, with 7 articles representing 44% of the total publications. Studies(A3, A6, A7, A8, A12, A13, A15) were all conducted and published in China. The USA follows with 4 publications(A5, A11, A14, A16). Moreover, there have been just two publications from Malaysia(A2, A9). Besides that, there is one (A 1) from Saudi, one (A4) from South Africa, and one(Article 10) from Greece. Figure 4 shows the Geographical Locations.
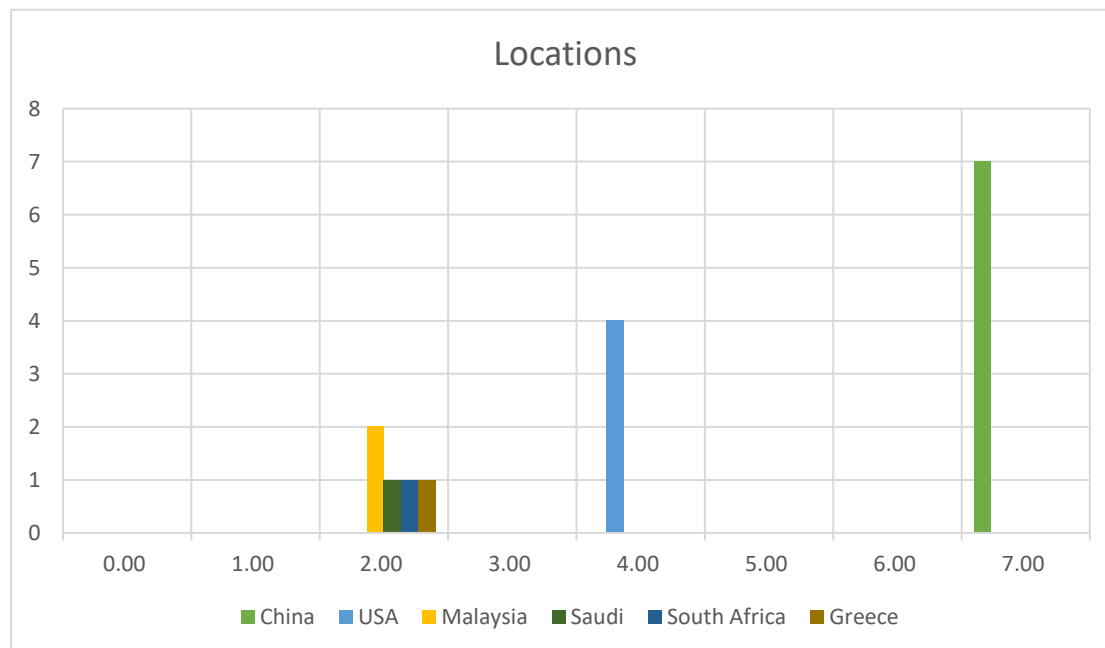

Figure 4. Geographical Locations

Challenges and Limitations of the Studies

Based on the analysis of the literature review, there have been various challenges and limitations of instructional design within flipped classroom settings. The main challenges and limitations are as follows: 1. challenges in flipped classroom settings, include students not familiar with the flipped classroom, the low quality of pre-class videos, limited question-asking opportunities, teacher negativity, and difficulties in motivating and monitoring student participation(A1). 2. resource constraints and a lack of teacher training. Students' low readiness due to limited practical exposure, and lack of fundamental knowledge, especially in using hand tools. Besides, limited resources, inadequate training, and a need for accessible modules and handbooks to support teachers in reference and idea generation(A2). 3. Environmental Challenges, such as Students encountered environmental challenges and had to establish a conducive learning environment in their residences or dormitories to facilitate knowledge acquisition(A4). 4. Challenges of course content and delivery(A6). Pre-class activities in flipped classrooms can be organized and designed in various ways, not only instructional video(A7). 5. Limitations of culture and context. The single-university research limits generalizations, particularly in language learning. It lacks student engagement indicators, doesn't explore facilitators' interactions, and relies on potentially biased student self-reports (A13). The research is limited by its focus on a single institution, making data non-generalizable(A14). 5. Limitations of research methods. Limitations of this research include a

limited scope of Participants, Incomplete examination of Variables, and limitation of self-reported data(A15). The research methods are relatively monotonous to understand how to improve a course(A16).

Recommendations for the Future Studies
From the analysis of the collected reviewed literature, we can discover that the main piece of advice is that future studies should investigate the effectiveness of flipped classroom settings across different learning contexts and disciplines. For example, future studies should focus on exploring and optimizing the design of pre-class activities and replicate this study in other study areas to investigate its effectiveness in promoting the development of higher cognitive levels of learning(A7). There are also design concepts and suggestions(technology integration, variety of research methods, optimize the course delivery) to build an appropriate and effective framework for instructional design within flipped classroom settings. Future studies should focus on seamlessly integrating educational design models and database design models within the ever-evolving context of the flipped classroom environment(A1). There is a need to create a flipped classroom and project-based learning module for D&T subjects using the DDR model, considering design thinking(A2). Preserving the effectiveness of university teachers in implementing innovative teaching approaches requires future studies to emphasize teachers' choices and decision-making autonomy in collaborative work(A3). A personalized teaching-and-learning system should be developed to enhance students' personal characteristics and learning skills(A12). A data-driven PREP approach should be adopted to continuously enhance the curriculum, specifically targeting challenges associated with cognitive load and time management for novice learners(A14).

Discussion
Instructional design refers to the systematic and efficient process of creating educational courses, training plans, and learning experiences. This process includes a detailed analysis of learning needs and goals, followed by the system or strategy developed to achieve these goals.

This SLR offers valuable perspectives on the current research status of instructional design within flipped classroom settings and highlights the issues that future research should consider. The purpose of this SLR is to understand the Instructional design research within the flipped classroom settings. Based on this research, researchers in this field will have a clearer understanding of the development direction and research gaps of ID, and apply them to new research projects."

Instructional Design Models and Categories
This SLR uncovers a range of interesting and significant insights. It is evident from our study that the majority of ID research covers a variety of models and categories. When we examine the instructional design model and categories employed in the collected literature review, the trend reflects a shift towards the more technology-integrated, more learner-centered instructional design model. For instance, Elsigini and Yamani (2021), suggested integrating educational design models and database design models to contribute to the development of flipped classroom settings and raise the level of graduates. In addition, Deng, Feng, and Shen (2023) proposed an innovative instructional design model in their research. That is using video-based fipped classrooms with question-embedding to improve students' learning

process and outcome. Moreover, Zhang and Fang (2022) developed an instructional design of FC into TPACK constructs to enhance the understanding of teacher efficacy within flipped classroom settings.

Types of Instructional Strategy

Based on the examination of the publications, we found a variety of instructional strategies implemented in the flipped classroom settings. Among this literature, active learning is the most commonly used strategy, followed by the collaborative learning strategy. Further, other researchers implemented numerous kinds of instructional strategies in their studies, including project-based learning, inquiry-based learning, and technology integration. For future research, we recommended integrating more instructional strategies into the design of the flipped classrooms. This approach aims to foster the development of flipped classrooms and enhance students' learning outcomes.

Variety of Technological tools and platforms

This SLR provides an overview of various technical tools and platforms used in flipped classrooms in different countries and regions. There are online learning platforms such as Zoom, Rain Classroom, TronClass, Xiaoya, Moodle, and Canvas, as well as specific platforms such as MyEducator and Unipus. Each tool is integrated with specific instructional design models or strategies, demonstrating the application of modern technology within flipped classroom settings. The technologies play a crucial role in addressing the challenges and limitations of contemporary educational environments, contributing to the development of educational technology. In future research, especially in flipped classroom settings, there is an increasing need to develop more personalized, and data-driven tools or platforms to facilitate personalized learning for students, address specific challenges, and improve learning outcomes.

Geographical Locations

Our analysis reveals that the epicenter of flipped classroom research is mainly in China, followed by the United States. Therefore, we can conclude that China, being the largest developing country, has leveraged its robust infrastructure to facilitate extensive research in flipped classroom research. In addition, it can be seen from the results that several developing countries have conducted instructional design research in flipped classroom settings, in Saudi and Malaysia. This indicates that the emphasis of future research on flipped classrooms will transition toward Asian countries.

Challenges and Limitations of the Studies

Understanding the challenges and limitations of current research can serve as the key guidelines for future studies. Based on the analysis of the above literature, we summarize the challenges and limitations in the current research on flipped classroom instructional design, considering the perspectives of students, instructors, and research methods.

The students' limited familiarity with the flipped classroom model and the lack of opportunities for students to ask questions impede students' engagement and comprehension. In addition, low-quality pre-class videos prevent students from achieving sufficient pre-class accuracy. Moreover, the learning environment challenges faced by

students, as well as their unfamiliarity with specific technologies, can also affect learning outcomes.

Teachers encounter challenges of resource scarcity and insufficient training and often find it difficult to find suitable sources, tools, or websites for classroom use. This highlights the need for easily accessible modules and handbooks to assist in reference and idea generation. Besides that, The poor quality of video lectures presents a major obstacle in delivering comprehensive course content. Teachers face difficulties in balancing course content while integrating students' personal experiences and cultural backgrounds.

In some research, the research results are difficult to adapt to populations with different regions and cultural backgrounds, and cannot be widely promoted to a wider range of educational environments due to cultural and regional limitations, limited sample size, and reliance solely on the research scope of a single school or institution. Therefore, the research findings may not be sufficient to provide a comprehensive understanding and guidance for curriculum improvement.

Recommendations for the future studies
The correct use of instructional design models, instructional strategies, technological tools, and platforms is needed for a great design within flipped classroom settings. It is necessary to emphasize the importance of teachers' choices and autonomous decision-making in collaborative work, especially when implementing innovative teaching methods. The technology integration needs to be aimed at promoting personalized learning for students. There is an increased need to identify the effectiveness of flipped classroom instructors in their instructional design. The sample size and research population need to be increased to enhance the generalizability of the research. Diversification of research methods is needed to increase the accuracy of research. The instructional design within a flipped classroom is very professional. Teachers are the core of instructional design. Universities should invest in the professional development of teachers and provide them with a large number of training opportunities.

Limitation
This SLR examined ID within the flipped classroom settings, including instructional design models, instructional strategies, platform tools, challenges, and recommendations for future research. In our research process, we mainly sorted out the Scopus database to retrieve relevant data. Because using multiple databases simultaneously can lead to duplicate literature. However, there are still some obstacles that need to be overcome during the investigation process. Firstly, not all searched articles can be found, and only 16 articles were left for research. Secondly, future research can focus on the ID in flipped classrooms from different perspectives, such as samples, research methods (qualitative method, quantitative method, or mixed method), and learning outcomes.

Conclusions
Instructional design is a fundamental concept in the field of education. It is a systematic and scientific process for creating effective, efficient, and engaging learning experiences. In recent years, with the widespread use of flipped classrooms, the Instructional design within flipped classroom settings has also begun to receive a lot of attention. This SLR examined

publications based on their instructional design, instructional strategies, tools and platforms, geographical locations, challenges and limitations, and recommendations for future work. A future study is proposed to develop a more technology-integrated, more learner-centered instructional design model within flipped classroom settings. Besides, active learning and collaborative learning are still two main kinds of instructional strategies implemented in flipped classrooms. Future studies should use different kinds of instructional strategies according to their learning objective. As to technological platforms and tools, personalized and data-driven tools or platforms should be developed to facilitate students' learning. Moreover, the challenges and limitations of the analyzed publications have been listed. Based on this, we proposed some recommendations for future study. A great instructional design should include an appropriate instructional design model, instructional strategy, platform, etc. Future ID research in flipped classrooms in Asia is anticipated to mainly contribute to the development of ID.

Appendix: List of reviewed articles

Label	Article	ID Model or Categories	Instructional strategy	Technological tools and platforms	Location	Challenges and limitations	Future agenda
1	A1	Database model and ADDIE model	Not mentioned	Database Management System (DBMS)	Saudi	Flipped classroom challenges include student unfamiliarity, low-quality pre-class videos, limited question-asking, teacher negativity, and difficulties in motivating and monitoring participation.	Future research should focus on seamlessly integrating educational design models and database design models within the ever-evolving context of the flipped classroom environment
2	A2	DDR model	Project-based Learning	LMS	Malaysia	Students' low readiness due to limited practical exposure, and lack of fundamental knowledge, especially in using hand tools; Limited resources, inadequate training, and a need for accessible modules and handbooks to support teachers in reference and idea generation;	The study aims to create a flipped classroom and project-based learning module for D&T subjects using the DDR model. Emphasizing design thinking, the module aims to offer unique insights beyond traditional approaches, better-preparing students for current challenges.

3	A3	TPACK and teacher efficacy theories	Collaborative learning	Unipus	China	Language teachers may struggle to find suitable resources, tools, or websites for their classes, facing issues with video lecture quality that may hinder comprehensive course content coverage	Preserving the effectiveness of university teachers in implementing innovative teaching approaches requires future studies to emphasize teachers' choices and decision-making autonomy in collaborative work
4	A4	Constructivist-based model	Technology integration	Zoom	South Africa	Students encountered environmental challenges and had to establish a conducive learning environment in their residences or dormitories to facilitate knowledge acquisition.	For improved validity, future studies should involve a larger sample size and pilot the questionnaire with a greater number of participants.
5	A5	Tisch Library's asynchronous tutorial modules	Active learning	Zoom	USA	Challenges of Creating and delivering comprehensive first-year programs include considerations such as reach, sustainability, instructional design, the flipped classroom, and assessment.	The experience with the flipped classroom model should be transferable beyond the COVID-19 period and applicable to classrooms beyond the library setting.
6	A6	Four-element flipped learning model: situation, interaction, experience, and reflection	Active learning	Rain Classroom platform	China	The flipped classroom approach, created for an Educational Technology course, may have varied effectiveness in courses with different teaching methods. Study results may not universally apply to	Future studies should identify the flipped classroom in other courses or other learning platforms

						students from other universities, given the specific technology (Rain Classroom) used and participants' familiarity with it. Outcomes may differ for students with lower proficiency in Rain Classroom.	
7	A7	Question-embedding flipped classroom	Active learning	TronClass	China	Pre-class activities in flipped classrooms can be organized and designed in various ways, not only instructional videos.	Future studies should focus on exploring and optimizing the design of pre-class activities. Additionally, researchers could replicate this study in other study areas to investigate its effectiveness in promoting the development of higher cognitive levels of learning
8	A8	Concept maps	Active learning	Xiaoya online learning platform	China	The research did not differentiate semantic correctness when examining the structural features of concept maps.	The study finds that learners' online learning knowledge structure aligns with the specific teaching context. More research is needed to apply this conclusion to other online learning contexts.
9	A9	Flipped Classroom Model	Collaborative learning	LMS	Malaysia	The findings may not apply universally to populations in different locations and cultures.	Future studies are necessary to examine the influence of FCM on learning outcomes and to what extent.

10	A10	OER(Open educational resources) flipped classroom	Active learning	Moodle forums or email	Greece	Limitations include a small, voluntary sample from Greece, potential differences in trainee characteristics, limited subject availability over three months, and the use of asynchronous communication tools in the study.	Future research should focus on the impact of trainees' demographics and course design on engagement with flipped instruction, emphasizing the importance of context-sensitive integration of video lecturing and the need for comprehensive studies on local challenges and perceptions
11	A11	Design heuristics	Inquiry-based learning	LMS	USA	Instructors often face challenges balancing content coverage with integrating students' lived experiences and cultural resources when using CRP in classrooms.	Future research should focus on how FCs enable or limit experiences for all students in the classroom, with a focus on those historically marginalized in mathematics.
12	A12	Motivational model	Active learning	Moodle platform	China	Moodle lacks automated duration recording and timely teacher feedback for student difficulties. Moodle data analysis reveals that despite spending significant time in pre-classes, some students did not achieve the desired learning outcomes.	Future studies should focus on developing a personalized teaching-and-learning system that takes into account personal characteristics and learning skills.
13	A13	Task engagement flipped classroom model	Collaborative learning	Canvas online learning platform	China	The single-university research limits generalizations	Future research on flipped learning

						, particularly in language learning. It lacks student engagement indicators, doesn't explore facilitators' interactions, and relies on potentially biased student self-reports.	should analyze its effectiveness across diverse contexts, considering the influence of context and discipline on task engagement; explore student task engagement, and utilize quantitative measures to obtain statistical results in the examination of engagement facilitators in flipped learning.
14	A14	Without cognitive overload instructional design	Active learning	LMS	USA	The research is limited by its focus on a single institution, making data non-generalizable	Future studies should endorse the adoption of a data-driven PREP approach to continuously enhance the curriculum, specifically targeting challenges associated with cognitive load and time management for novice learners.
15	A15	"O-PIRTAS" (Objective, Preparation, Instructional video, Review, Test, Activity, Summary) model	Active learning	online learning plat form	China	Limitations of this research include: Limited scope of Participants, Incomplete examination of Variables, limitation of self-reported data	The suggestions highlight the importance of broadening participant diversity, incorporating additional variables, employing direct measures to assess engagement, and investigating the use of standardized

							tests to improve future research on the flipped classroom model.
16	A16	Educational data mining to improve instructional design	Not mentioned	MyEducator platform	USA	The research methods are relatively monotonous in understanding how to improve a course	Future studies should focus on the Mixed Methods Approach, Learning Analytics Evaluation, Evaluation of Video Components, Tailoring Resources for Challenging Lessons, Understanding Non-Utilization of Resources, Efficient Learning Strategies, and specific lessons.

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